



CSIR NEWS

VOL. 20

15 JULY 1970 : 24 ASHADHA 1892

NO. 13

Working Group on Solar Energy : Proceedings of Second Meeting Held at CSMCRI

The second meeting of the Working Group on Solar Energy (India) was held on 30 and 31 March 1970 at the Central Salt & Marine Chemicals Research Institute (CSMCRI), Bhavnagar. Scientists from the Defence Laboratory, Jodhpur; Indian Institutes of Technology, Madras and Kanpur; Central Building Research Institute, Roorkee; and CSMCRI, Bhavnagar participated in the deliberations. A special feature of the group meeting was the participation of Prof. Farrington Daniels, who also delivered two lectures on 'Present state of solar energy uses' and 'Researches and future application of solar energy'. Prof. Daniels stressed the need for examining sociological problems involved in the application of solar energy. He further suggested that the feasibility should be examined of putting up small family size house machines for making ice under Indian conditions and added that there was scope for making portable fuel pumps.

Presiding over the meeting, Dr D. S. Datar, Director, CSMCRI, Bhavnagar, reviewed the recent trends in solar energy utilization in the field of space exploration programme and agricultural applications. Although economic collection of solar energy still poses a problem, certain applications like solar distillation, water heating, etc. are establishing their importance in certain regions. Dr R. L. Datta (CSMCRI, Bhavnagar), convener of the working group, presented the report of its activities since it last met in November 1967. He also presented a report on the International Solar Energy Society Conference held in Melbourne in March 1970.

Individual reports from the participants followed the key paper (S. D. Gomkale, CSMCRI) which gave an overall account of the research activities

in the field of solar energy in various institutions in India. A report on the measurements of solar radiation intensities at Bhavnagar as measured in the principal radiation station at CSMCRI was presented by M. M. Bhat of the institute. Based on the measurements during the last three years the average solar radiation intensity at Bhavnagar has been found to be 490-500 cal/cm²/day. Explaining the work on solar distillation in progress at CSMCRI, S. D. Gomkale reported that efforts were under way to develop small and easy-to-install solar stills with black plastic film and aluminium sections. G. C. Jain (CSMCRI, Bhavnagar) described briefly the work done on the solar pond at the institute and presented the results obtained with the pond of size 170 ft × 54 ft. Difficulties encountered and modifications to circumvent them were also discussed.

Work on water and space heating and measurement of solar radiation and illumination, being carried out at CBRI, Roorkee, was presented by H. P. Garg of the institute. Suitable instruments have been developed for the measurement of absorptance, bond conductance and film heat transfer coefficients. Water heaters—domestic type (140-litre capacity) and medium size (600-litre capacity)—have been developed. The performance of the heaters has been evaluated for climatically differing cities like Delhi, Poona, Bombay, Madras and Roorkee. The medium sized heater has six absorbers of 15 ft² area each and water is heated up to 55°C. The heater is fitted with a small booster pump (1/16 hp), an immersion heater and a solar switch. Licences have been given to firms for fabricating the units.

The work done at the Defence Laboratory, Jodhpur was the subject

of a paper by J. P. Gupta of the laboratory. He described an aluminium solar water heater constructed, in which a rise of 25°C at a flow rate of 25 litres/hr has been obtained. The collector area of the heater is 1.14 m² and the efficiency obtained is about 60%. With inverted V-type solar stills, an yield of about 3 litres/m² × day has been obtained during summer. The development of a solar still with black porous bottom and plastic covers was also reported. A paper contributed from IIT, Madras described appliances designed and fabricated at the institute. These included an electrically compensated pyrheliometer, cheap solar water heater with a flat collector of aluminium covered with glass, a family size desalination unit and solar evaporative cooling and steam generating unit with a concentrator. The water heater has a storage capacity of 90 litres and an efficiency of 65%.

The possibility of linking the working group with the International Solar Energy Society was discussed, and the organizations in India engaged on investigations on solar energy were advised to become members of the International Solar Energy Society. An advisory body of the working scientists of the organizations engaged in investigations on solar energy was formed with Dr R. L. Datta as chairman and Shri S. D. Gomkale as secretary.

Beneficiation of Limestone from Tal

Batch and pilot plant beneficiation studies were carried out by the National Metallurgical Laboratory, Jamshedpur to develop a process flow-sheet for a beneficiation plant for treating 1200 tonnes of limestone per day as well as for producing limestone concentrate suitable for the manufacture of cement from low grade limestone from Tal, Garhwal Dist. (U.P.). The sample sent by the Directorate of Geology and Mining, Government

of U.P., contained 38.07% CaO, 24.28% SiO₂, 2.76% Al₂O₃ and 2.10% Fe₂O₃. Petrological examination of the sample showed that it was to be crushed to about 100 mesh size for liberating calcite from the gangue.

Batch tests with the sample ground to 81%—200 mesh using oleic acid emulsion as collector and sodium silicate as depressant for gangue minerals yielded a calcite concentrate assaying to 46.4% CaO, 8.4% SiO₂, with a recovery of 97.2% CaO. Use

of soap and rosin as collector also yielded a concentrate assaying to 46.5% CaO, 10.2% insolubles, with a recovery of 97.3% CaO.

Based on the results of batch tests, a flow-sheet was developed for pilot plant operation in which large scale trials produced a concentrate assaying to 46.4% CaO, 10.5% SiO₂, with a recovery of about 92% CaO. Design data for the installation of a beneficiation plant suitable for treating 1200 tonnes of the sample per day were also worked out.

Manufacture of Silicon Carbide by the Process Developed by RRL, Hyderabad

Silicon carbide is a strategic material having a wide range of applications. It is prepared in several grades and types to meet various end uses which depend on the predominance of one or more of the following properties: extreme hardness and abrasion resistance, high mechanical strength, refractoriness, chemical inertness, thermal resistance and electrical conductivity.

Applications

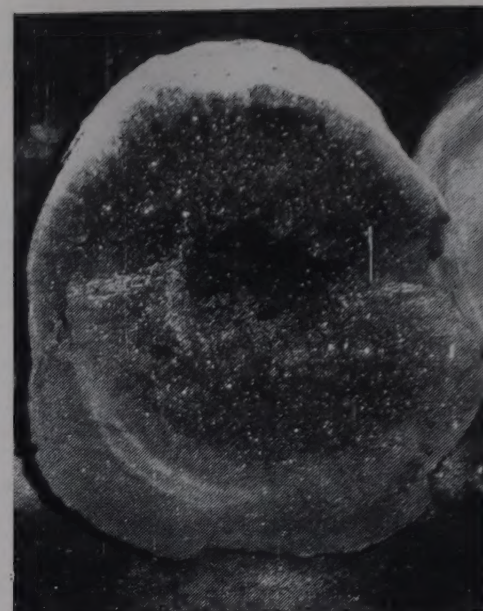
Silicon carbide is mainly used in the preparation of abrasives (bonded, coated, loose grain and paste), wear resisting surfaces (brake-lining, non-slip applications), refractories (kiln furniture, muffles, bricks, electric furnace lining mortar and crucibles), electric devices (heating elements for high temperature industrial furnaces, infrared heating, varistors and voltage-sensitive devices) and in

metallurgy (de-oxidizer in ferrous metallurgy). Other applications of silicon carbide are in the preparation of catalyst carriers, tower packing, pebbles and pebble heaters, welding rod compositions, abrasive-resistant paints and in nuclear engineering and rocketry.

Process

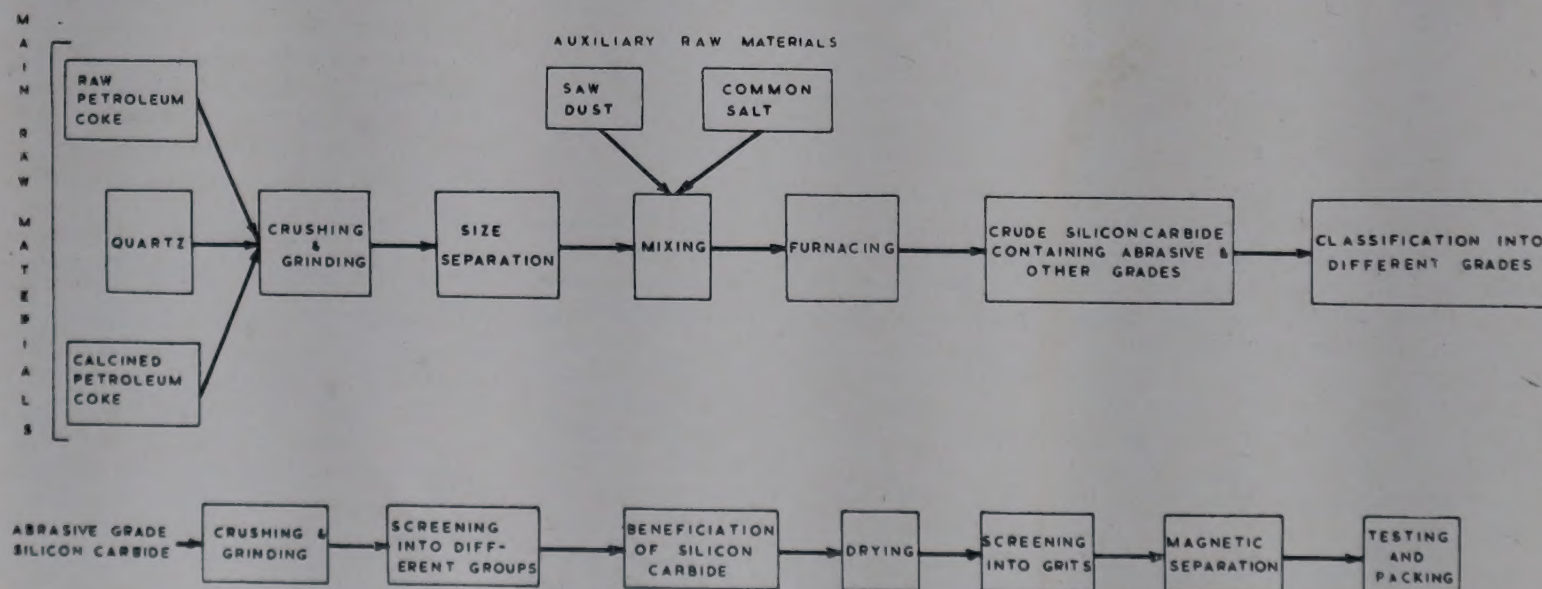
Silicon carbide is manufactured by reduction of silica with a carbonaceous material in an electric resistance furnace at a temperature of 2000-2200°C, followed by a size separation and purification treatment. The main raw materials are quartz or sand and coke or other carbonaceous materials.

The raw materials are individually crushed, ground and screened to obtain the requisite particle size. The homogeneously mixed charge is



Cross-section of the silicon carbide slug

fed into electrically operated resistance furnaces in which a centrally located carbonaceous core acts as the resistor. The furnace is operated for 30-40 hr at constant kVA. The main byproduct of the reaction, carbon monoxide, burns at the sides and top of the charge during the reaction. The furnace is cooled and the product discharged taking care to classify the product into different grades, viz. abrasive grade, refractory grade, etc. Each grade is processed separately. The crude lumps are crushed, ground and screened into a few particle size groups. Each group is treated to remove the impurities, i.e. free carbon, free silicon and iron. The beneficiated silicon carbide is screened into specific grits, magnetically treated, tested and packed.



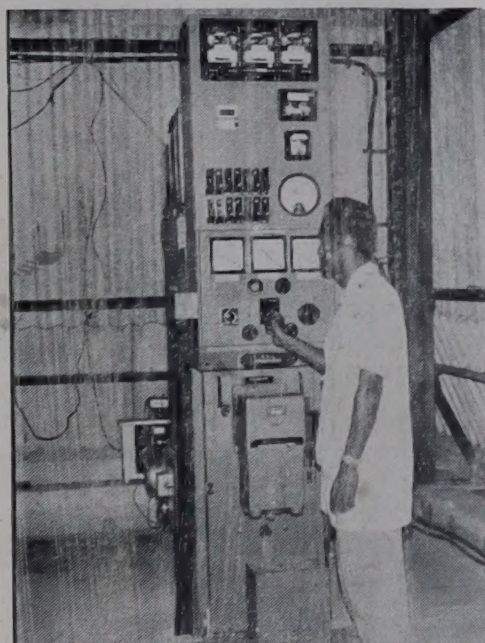
Silicon carbide is manufactured by only a few firms in the world and the technology for its manufacture is a closely guarded secret.

Demand

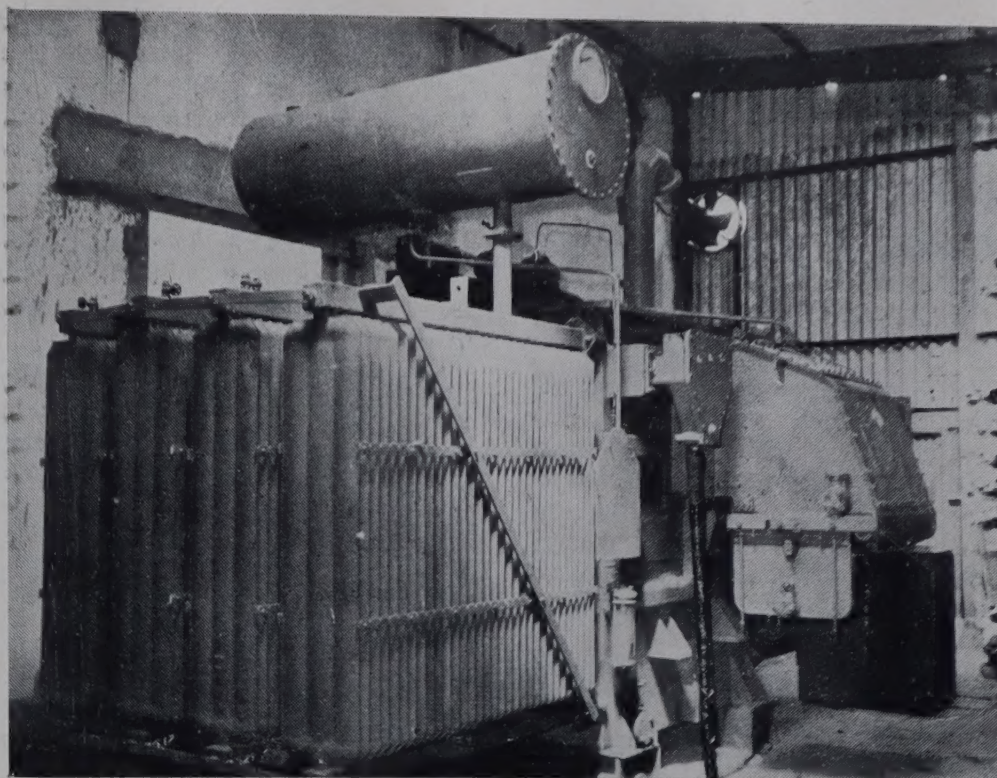
India has been importing increasingly large quantities of silicon carbide during the last decade, both as raw silicon carbide and in the form of various finished products. The present imports of the silicon carbide grain are over 2000 tonnes per year, valued at more than Rs 42 lakhs. The requirements are expected to increase to about 4000 tonnes a year in the near future. Although India has all the raw materials and other resources needed for the production of silicon carbide, there has so far been no indigenous production.

Work done at RRL, Hyderabad

Realizing the need for developing indigenous technology for the manufacture of silicon carbide, the Regional Research Laboratory (RRL), Hyderabad undertook work on the synthesis of silicon carbide in 1960. After carrying out an extensive study of the various raw materials, process variables, physical and chemical and electrical properties of the product obtained, the laboratory took up the production of silicon carbide on an experimental unit of 75 kg per day capacity. The unit, which was put into operation in 1966, has helped in further study of process variables and in assessing the marketability of the product.



Control panel for furnace transformer



Furnace transformer (1000 kVA) designed by the Heavy Electricals Ltd, Bhopal on the basis of data provided by RRL, Hyderabad

The process worked out by the laboratory utilizes indigenously available quartz, and petroleum coke, sawdust and salt. The production of silicon carbide is a power intensive industry. The laboratory has been able to produce silicon carbide comparable to the imported product which has been found acceptable by various consumers. Over four tonnes of silicon carbide have so far been produced on the experimental unit and supplied to consumers for trials and to meet their immediate requirements.

M. N. Dastur & Co. (P) Ltd have prepared a feasibility report based on the data provided by RRL, Hyderabad, according to which 3000 tonnes/annum plant would be highly profitable.

Inclusive of all items of cost, such as land and site development, plant and equipment, spares, contingencies, engineering and design, construction, administration and capitalized interest on loans, etc., the total capital investment required for the plant is estimated at about Rs 11.05 millions.

The total estimated product cost, inclusive of selling expenses, depreciation and interest charges, for silicon carbide abrasive grains produced is about Rs 2400/tonne,

assuming that power is available at 5 paise/unit. Based on a selling price of Rs 3250/tonne, the plant is expected to earn a total profit of about Rs 1.60 millions at the end of the second year of operation with a production of 2500 tonnes. At the end of the seventh year of operation, after repayment of the entire loan capital of Rs 4.84 millions in the previous year, the plant is expected to earn a maximum profit of about Rs 3 millions per year.

Further developmental work on the project has been taken up and a prototype furnace of capacity 3 tonnes of product per charge has been set up with the object of further refining the furnacing process and demonstrating the efficiency and yields on a commercial scale. The furnace has been recently commissioned and the product obtained is found to be satisfactory. The prototype unit has been set up using entirely indigenous equipment. The 1000 kVA transformer was designed and supplied by the Heavy Electricals Ltd, Bhopal, based on the data provided by RRL. Bus-bar, another important component, was designed by the laboratory and fabricated by a local firm.

The process technology and the product developed by RRL, Hyderabad are comparable in efficiency and

quality to those offered by the leading foreign firms. The laboratory is in a position to provide all the operational and design data required for the establishment of commercial plants.

Morphological and Phylogenetical Studies on Some Aspidiaceae (sensu Copeland) Polystichoid and Thelypteroid Ferns

The ferns are a vast group of vascular cryptogams over 90% of which are restricted to tropical forests. Due to difficulties encountered in their collection and cultivation, most of these plants have remained practically unknown. There is great confusion regarding their taxonomy and nomenclature. Ferns constitute a predominant part of Indian vegetation and are particularly abundant in the humid areas of the country. Among the various Indian ferns, the Polystichoid and Thelypteroid groups are particularly little known, even though they are widespread in the country and rich in their variety. Their taxonomy, nomenclature and relative position in the phylum are of controversial nature.

Nine Indian genera (45 species) belonging to these groups were studied by Shri Prakash Chandra of the National Botanic Gardens (NBG), Lucknow. The total morphology of the sporophyte as well as gametophyte of the individual species was investigated with special reference to spore morphology, prothallial development and morphology of juvenile plant, anatomy of the rhizome (with particular stress on the nature and organization of the stele), nature and development of dermal appendages, and sporangial morphology. By a process of total morphological comparisons with supposedly related groups like the Tectarioid, Dryopteridoid, Woodsoid, Lomariopsidoid, Peranemoid and Dennstaedtioid ferns, it was concluded that the Polystichoid ferns possibly evolved independently from an ancient stock, possibly related to the present-day Cyatheaceae, along with the other major groups of Aspidiaceae ferns like the Dryopteridoid and Tectarioid groups. Though possibly evolved from the same Cyatheaceous stock, the Thelypteroid ferns represent a separate line of evolution, independent of the Aspi-

diaceous genera. This justifies the separation of these genera into an independent family, the Thelypteridaceae. Morphological comparisons also indicate relationship of the Thelypteroid ferns to the Aspleniaceae and the Grammitidaceae, although the latter two groups are specialized in their own way and none is probably parental to each other.

Shri Prakash Chandra, who carried out the research under the guidance of Dr B. K. Nayar of NBG, was awarded the Ph.D. degree (1969) of the Agra University for his thesis based on the investigation.

Chemical Investigations on the Constituents of Some Economic Plants

Chemical investigations on all the parts of *Pithecolobium dulce*, trunk bark of *Acacia caesia* (Leguminosae), nuts and trunk bark of *Calophyllum tomentosum* and *C. apetalum* (Guttiferae) and seeds of *Cosmos bipinnatus* and *C. sulphureus* (Compositae) have been carried out by Shri S. K. Nigam of the National Botanic Gardens (NBG), Lucknow.

The various constituents were isolated from the plant material by conventional solvent extractions, solvent segregation, column chromatography over alumina, silica gel and cellulose powder for clear-cut separation and purification of the minor as well as the major constituents. Finally, the proanalytical and TLC pure samples of the compounds were prepared by re-chromatography and crystallization from different solvents. The known constituents were characterized and identified by their physico-chemical properties and degradation products, co-TLC, mixed melting points and superposable infrared spectra, while the structures of the hitherto unknown compounds were elucidated by the study of their infrared, ultraviolet, nuclear magnetic resonance and mass spectra substantiated by the conventional methods.

The *P. dulce* seed, apart from other constituents, yielded a substantial amount of lecithin (1.2%) and saponin (2.4%). A process has been evolved for the large scale isolation of the seed lecithin freed from the toxic saponin, the genin

part of which was a mixture of oleanolic and echinocystic acids and the sugar moiety was in the sequence, xylose, arabinose and glucose. Of the minor constituents, β -D-glucoside of α -spinasterol was isolated from the bark, flowers, leaves and seeds. Quercetin and kaempferol were the flavonoids present in the seeds, heartwood and flowers and a substantial amount of kaempferol as well as its 3-rhamnoside was isolated from the leaves. β -Sitosterol, campesterol and stigmasterol and their glucosides have been found in the seed pulp, heartwood and root. The tannin-rich bark yielded lupeol, lupenone and fatty acid ester of α -spinasterol. Hexacosanol was present in the seed pulp, flowers and bark, while hexacosane in the flowers and octacosanol and a carotenoid in the leaves.

The new 4-substituted coumarins, tomentolide-A (4-phenyl) and tomentolide-B (4-propyl) from the *C. tomentosum* nut and apetalolide (4-phenyl) from the *C. apetalum* nut have been isolated and their structures elucidated. The bark of *C. tomentosum* yielded friedelin, friedelin- 3β -ol and β -sitosterol and that of *C. apetalum*, friedelin, β -amyrin, betulinic acid and β -sitosterol.

Cosmos bipinnatus and *C. sulphureus* seeds yielded β -sitosterol and a fixed fat (18 and 16% respectively). The former also yielded β -D-glucoside of β -sitosterol.

Lupeol, α -spinasterol and stigmasterol are the constituents of the bark of *Acacia caesia*. The chemical constituents did establish that *A. caesia* and *A. intsia* are not the same plants.

The lecithin of the *P. dulce* seed can replace soya lecithin, an imported raw material for various industries. The purified and refined fat is as good as any other leguminous fat and can be utilized for edible purposes.

The calophyllolide from *Calophyllum inophyllum* nuts is a therapeutically active compound and as such tomentolide-A and tomentolide-B, and apetalolide need thorough clinical trials.

The fatty acid composition of the *Cosmos* fats does not fit in with

the characteristic pattern of the compositae fats.

Shri Nigam, who carried out the investigations under the guidance of Dr C. R. Mitra of the Utilization Research Laboratory of NBG, was awarded the Ph.D. degree of the Lucknow University (1969) for his thesis relating to the work.

Chemical Investigations on Indian Medicinal Plants

Chemical investigations of five plants, viz. *Celsia coromandelina* Vahl., *Ficus glomerata* Roxb., *Cissampelos pareira* Linn., *Anthocephalus indicus* and *Diospyros melanoxylon* Roxb., of repute in the Indian system of medicine, have been carried out by Shri A. R. Chowdhury of the National Botanic Gardens (NBG), Lucknow. Some steroids, triterpenoids and alkaloids have been isolated and their structures established using infrared, ultraviolet, nuclear magnetic resonance and mass spectra.

Celsanol, a new sterol, was isolated from *C. coromandelina* and its structure established as stigmastan- $\Delta^{5,9(11)}$ -diene-3 β -ol. A new tetracyclic triterpene, gluanol acetate, β -amyrin and β -sitosterol were isolated from the leaves of *F. glomerata*. The structure of gluanol acetate was established as 13 α , 14 β , 17 β (H), 20 α (H)-lanosta-8,22-diene-3 β -acetate.

The chemical examination of leaves of *C. pareira* was done to find out an additional source of hayatin, which possesses neuromuscular blocking properties, without killing the plant. The alcoholic extract of leaves on acid-base treatment followed by preparative TLC yielded five crystalline alkaloids which were identified as hayatin, hayatinin, hayatidin, cycleanine and l-bebeerine.

Hentriacontanol and β -sitosterol were isolated from the leaves of *A. indicus* and identified by usual methods.

α -Amyrin, hentriacontane and hentriacontanol were isolated from the leaves of *D. melanoxylon*. These compounds have not been isolated so far from this plant.

Shri Chowdhury, who carried out the investigations under the

guidance of Dr A. B. Sen, Professor and Head, Department of Chemistry, Lucknow University, Lucknow,

was awarded the Ph.D. degree (1970) by the Lucknow University for his thesis based on the study.

PROGRESS REPORTS

SERC Annual Report 1969-70

In view of the current trend towards 'limit states' design recommended by the European Committee in its proposed International Code for Reinforced and Prestressed Concrete, the Indian codes of practice require to be recast into the new format. The annual report of the Structural Engineering Research Centre (SERC), Roorkee for 1969-70, published recently, shows that the centre devoted considerable attention to this problem. Cracking and deflection being two of the important limit states, SERC's efforts were mainly concerned with these aspects. For instance, the crack control characteristics of beams reinforced with deformed bars were studied in comparison with beams reinforced with mild steel. At the same steel stress the maximum crack width for beams reinforced with deformed bars was 25% less than that for companion beams reinforced with mild steel. The tests also showed that at the maximum permissible steel stress, which is 50% higher for deformed bars than for mild steel bars, the maximum crack width is only 10% higher but less than the maximum limit, 0.2 mm, allowable by the International Code. At the same steel stress, deformed bars showed better crack control characteristics.

Accurate calculation of the short- and long-term deflections of reinforced concrete flexural members has also acquired importance with the current trend towards limit states design. The limit state of deformation being one of the CEB-recommended limit states, the centre developed a method of computing short- and long-term deflections of rectangular and T-beams with a view to providing guidance to designers.

A study of the requirements of steel in the design of reinforced concrete slabs by the elastic and yield line theories as well as by Hillerborg's modified strip method was made. The results show that a saving of 25-40% of the steel required can be

effected if the slabs are designed according to the elastic theory method of IS: 456-1964. The saving will be 12-30% in reinforcement if the Hillerborg's strip method is employed. A computer programme has been developed for the analysis of thick-walled axisymmetric shells used for prestressed concrete nuclear reactor pressure vessels. Another computer programme developed is for arriving at the optimum design of prestressed concrete flexural members prestressed to different degrees corresponding to Class I, Class II and Class III classification evolved by FIP-CEB. The programme can accommodate any code of practice.

To evaluate the suitability of open web steel structures for covering large areas economically, SERC carried out a field investigation to cover an area of 9.75 m \times 25.60 m (32 ft \times 84 ft) employing a composite roof consisting of open web joists of 61 cm (24 in) depth acting compositely with a concrete slab of 5 cm (2 in) thickness. The investigation showed that, besides saving in cost, there is significant reduction in the dead weight of the structure.

A new investigation taken up during the year relates to the development of know-how for the design of complex machine foundations and to the improvement of current practices in view of the fact that such designs are mostly imported at present. An analytical investigation of a 200 MW turbo-generator foundation was completed taking into account the effect of longitudinal girders and the homogeneous distribution of mass in the frame members.

The structural analysis, design and supervision of one of the pavilions at the Gandhi Darshan exhibition (New Delhi, 1969) was carried out by SERC. A suspended structure using stressed-skin construction, it could be erected and dismantled quickly. The shape of the structure, covering an area of 40 m \times 40 m, was regulated by tensioning the cables threaded through the edges of the fabric. The material was supported at four peak

points at the centres of the four quadrants and held down at the centre. The peaks were supported by an outer cable system hung from four external columns while another system of eight dwarf columns was used to tension the membrane. Hand-woven khadi coated with polyvinyl chloride was used as the roofing material. The entire structure was erected in about a week's time.

Among the other achievements of the centre during the year, the design and fabrication of load cells using electrical resistance strain gauges as sensing elements may be mentioned. A prototype with a range of 50 tonnes was fabricated and subjected to extensive testing. Its performance both under static and dynamic loads was found satisfactory.

The centre brought out a revised edition of the Handbook on Ultimate Strength Design. This edition includes a method for computing short- and long-term deflections of flexural members, biaxial bending and treatment of unsymmetrical columns. Two workshops were organized at Bombay and Madras to acquaint practising engineers with the ultimate design and the use of deformed bars as concrete reinforcement.

Consultancy services continued to be one of the major activities of SERC. Some important services provided relate to: (1) structural and model analysis of an intake structure at Ichari for the Irrigation Department, U.P. Government; (2) design and drawings for the reinforced concrete structure at the Madras Lighthouse; (3) design and drawings for reinforced concrete water tank (1 40 000-litre capacity) at CSIR campus, Madras; (4) analysis of portal frames and space frames for the Yamuna Hydel Scheme, Dehra Dun; and (5) design of 100 m micro-wave tower for the Posts & Telegraphs Department.

International Indian Ocean Expedition Plankton Atlas

The Inter-governmental Oceanographic Commission held in May 1968 approved the proposals for the first phase of the Plankton Atlas of the Indian Ocean, based on the

collections received and processed at the Indian Ocean Biological Centre, Cochin. The first volume was issued in 1968-69. The second volume, a sequel to the first volume, has just been published by the Indian Ocean Biological Centre of the National Institute of Oceanography, Panaji. It contains ten maps (Vol. II, Fasc. 2) indicating the distribution of fish eggs and larvae in the Indian Ocean. The maps form a further contribution to plankton studies of the Indian Ocean and are issued as a basis for more intensive studies on the ichthyoplankton of this region of world oceans which is now attracting much attention from the point of view of fishery resources.

The Indian Ocean Biological Centre, Cochin received 1927 zooplankton samples collected in the Indian Ocean, out of which 154 were found to be standard samples and 379 non-standard. While the data from the standard samples were fully utilized for preparing the maps, the data from the non-standard collections were used only for indicating the presence of the groups.

The maps were prepared after subjecting all the plankton samples to a standard procedure. The basic working chart used for plotting the stations is the same as used by the physical and chemical groups working on the atlases for the Indian Ocean both at Hawaii and Kiel.

Non-destructive Methods of Testing Concrete: A Review Report

Non-destructive methods of testing are becoming more and more important in almost every field of technological development. In the field of concrete technology the conventional method of evaluating the strength of hardened concrete is by loading to failure standard cubes, cylinders or prisms. This method does not always reflect the true quality of the concrete. To assess the true quality of concrete in the structure, cores of concrete should be taken out and tested by the conventional methods. Taking out cores is not always possible and, even if possible, proper matching of the subsequent patch, formation of points of weakness, etc. pose problems. Hence there is need

for employing non-destructive methods for testing concrete, which are reliable, quick, relatively inexpensive, convenient to adopt and which leave the parent structure unaltered. These methods can be also employed for the detection of flaws and cracks, for the determination of the position of reinforcement and for the testing of concrete at site for the early removal of form-work. The non-destructive methods can also be used in the quality control of concrete in precast products industry and in the evaluation of certain other physical characteristics of concrete.

The mechanical properties of concrete are influenced by several factors not all of which can be easily taken into account simultaneously and hence no complete dependable method has yet been made available. In order to evaluate factors responsible for the lack of reproducibility of results in the existing methods and to determine ways of improving them, the Cement Research Institute of India, New Delhi has taken up a project on the development of dependable non-destructive methods of testing concrete. As a first step in this direction, a review report (RR-2-69) has been compiled and brought out by the institute.

Different methods of non-destructive testing, namely surface hardness methods, resonance methods, pulse velocity methods and radioactive methods, are dealt with in the review. The basic principles, apparatus used, applications, factors influencing the results and scope and limitations of each method are briefly presented.

The development of instruments for special purposes such as detection of the reinforcement in hardened concrete and measurement of concrete cover over reinforcement, etc. is also based on non-destructive testing techniques. Also, the methods have been employed for testing other non-metallic materials such as bituminous materials, soils, soil cement, etc. These aspects are also covered in the last section of the review report.

All the four methods have their limitations in application. These

methods cannot replace the destructive test for purposes of assessment of strength of concrete. Hence, in all cases, it is recommended that the data obtained may be interpreted taking into account all other available information of the job under test, including the strength data from destructive testing, if any. Non-destructive methods of testing concrete are for comparative qualitative assessment.

Some of the recent trends relate to the determination of damping properties of concrete, resonance

vibration of circular plates for determining the elastic properties of concrete and use of more than one observation in the statistical correlation of the strength of concrete. These are attempts towards either developing new procedures of estimating the strength and other properties of concrete or towards using the existing methods for getting more reliable data on concrete quality.

The report contains a comprehensive bibliography containing 682 references.

CSIR SUPPORT TO RESEARCH

Completed Schemes

Equatorial Ionospheric F2-layer Anomaly and the Electrojet

A bite-out effect is observed around mid-day in the F2-layer electron density NmF2 at the magnetic equator and consequently the latitudinal distribution of NmF2 shows an equatorial trough bounded by peaks at about $\pm 17^\circ$ magnetic latitude. A study was undertaken under a CSIR research scheme to see how F2-anomalies are related to the electrojet.

A statistical analysis was made of the critical frequency foEs data of the electrojet-associated q-type sporadic E-layer at Kodaikanal for the four years 1957-1960. Normally foEs values are much higher than foE during the interval 0900-1500 hr, which is also the interval of F2 bite-out. On days of abnormally high values of foEs (i.e. intensified electrojet), the bite-out in NmF2 is deepened, while on days of low values of foEs (i.e. weakened electrojet), the bite-out or trough in NmF2 becomes shallow. On the contrary, the H-component of the earth's magnetic field and the height of the F2-layer undergo changes of same sign as happen in foEs.

The above results have been explained as follows. An increase in foEs means increase in the eastward electrojet current or the E-region electric field and also the H-field. This electric field or its changes are communicated to the F2-layer along the geomagnetic field line,

thus producing upward ExB drift of electrons in the F2-layer and increase in such upward drift causes the bite-out in NmF2 to further deepen. Similarly a decrease in foEs or in the eastward E-region electric field causes reduction in the upward drift of the electrons in the F2-layer and hence the bite-out or trough anomaly in NmF2 is made shallow or nearly removed. The near-removal of the equatorial F2-anomalies is also observed on magnetically disturbed days when the H-field and foEs values remain below normal.

The above study was carried out by Shri J. C. Patel, a CSIR research fellow, working under the guidance of Dr K. M. Kotadia at the Department of Physics, Gujarat University, Ahmedabad.

Arthropod Fauna of Suspended Soils

A CSIR scheme entitled 'Studies on the arthropod fauna of suspended soils' functioned at the Department of Zoology, University of Calicut, Calicut from 7 Oct. 1968 to 10 July 1969. The investigator incharge was Dr K. J. Joseph, Professor and Head of the Department of Zoology, who was assisted by Shri C. M. Bobykutty, junior research fellow.

The study of the fauna of suspended soils is a new field of research in India. Suspended soils are soils found on horizontal branches of trees, soils among the network of roots of epiphytes and soils in tree holes. Forest areas are abundant in such suspended soils. One of the noteworthy features of these soils is that they are inhabited by diverse

groups of organisms which include oligochaetes, gastropods, isopods, pseudoscorpions, spiders, mites, centipedes, millipedes, spring-tails, silverfishes, earwigs, termites, bugs, caterpillars, beetles, weevils, ants and flies.

Temperature and humidity are important factors determining the variety and richness of the fauna. Besides, the percentage of organic matter present in the suspended soil is also significant, the fauna being rich especially with regard to Acarina and Collembola whenever the organic content is high. During favourable seasons when plants including grasses and small herbs are found growing from suspended soils on horizontal branches of trees, it was observed that the fauna was richer than at other times.

The microclimate of suspended soils is different from that of the ground soil. The dense canopy of leaves of the forest trees excludes direct sunlight, providing cool conditions of temperature. The effects of dew and rain are also checked. But direct exposure of these soils does occur when some of the trees shed their leaves during summer. During such times, the fauna is found to be rich.

Because the majority of organisms frequenting the microhabitat of suspended soils comprises arthropod groups, the present study was limited to the arthropod fauna. The collections made from various localities in Kerala have shown various forms of Isopoda, Arachnida (Pseudoscorpionida, Acarina and Araneida), Myriapoda (Diplopoda and Chilopoda) and Insecta (Collembola, Thysanura, Dermaptera, Coleoptera, Lepidoptera, Hymenoptera and Diptera). Very little is known about the coleopteran family Ptiliidae, collected for the first time in India from Kerala.

Although suspended soils shelter a rich and varied fauna, many groups that are found in the ground soil are seldom represented here. The true subterranean fauna, such as the Pauropoda, Protura and particularly the Symphyla, are rarely met with in the suspended soils. It is interesting to note that the fauna of suspended soils are mostly representatives of the superficial layers of the ground soil. This is especially true

because non-burrowing Acarina and Collembola are abundantly represented in suspended soils. It is, therefore, reasonable to agree with Delamare (1951) that the fauna of suspended soils had their origin from forms which migrated upwards from the ground soil. Many of the groups mentioned above have the habit of creeping up the trees through humid pathways such as spaces under bark, covered termite runways, etc. It has also been observed that as the height of the suspended soils on trees increases above ground, the fauna becomes more diverse. This is perhaps because the undisturbed microhabitat of the suspended soils offer their fauna highly suitable conditions for multiplication, diversification and evolution.

PATENTS FILED

126062 : An improved method for the removal of vanadium from vanadium pig iron, V. A. Altekar & P. P. Bhatnagar—NML, Jamshedpur.

126065: Improvements in or relating to the manufacture of activated carbons, K. Seshacharyulu, M. A. Sattar, K. S. Patil, P. S. Murti, E. R. Saxena & G. S. Sidhu—RRL, Hyderabad.

126120: A fluidized-bed reactor for carrying out reactions involving solids and gases, K. Seshacharyulu, P. S. Murti, M. A. Sattar, G. C. Gopi Reddy, R. Vaidyeswaran, B. S. R. Sastry & R. N. Parlikar—RRL, Hyderabad.

126178: Pressure vessel fabrication rig, A. K. Das, B. K. Sen, S. S. Seth & S. K. Nandi—CMERI, Durgapur.

126179: An improved method of constructing compaction piles, K. G. R. S. Jain, M. P. Jain & C. Prakash—CBRI, Roorkee.

126354: A process for obtaining useful steroids from a new plant source, S. Dev, V. D. Patil & U. R. Nayak—NCL, Poona.

126391: Extraction of tartaric acid from tamarind leaves, B. K. Saikia, R. C. Das & M. S. Iyengar—RRL, Jorhat.

126392: Low cost paper houses, N. C. Nandi, B. P. Chaliha, A. C. Khazanchi, S. B. Lodh & M. S. Iyengar—RRL, Jorhat.

126393: An improved method for the manufacture of calcium hypophosphite, M. Goswami, J. Lobo & P. H. Brahme—NCL, Poona.

126439: Improvements in or relating to preparation of phosphor grade zinc sulphide material useful for luminescent devices, C. V. Suryanarayana & (Miss) Alice Kurian—CECRI, Karaikudi.

126456: Improvements in or relating to the manufacture of ergotamine tartrate and other ergot alkaloids from the sclerotia of *Claviceps purpurea* (ergot of rye), Mansa Ram—RRL, Jammu.

126506: A process for making a print of a document with an electrophotographic machine, P. C. Mehendru, D. C. Parashar, G. D. Sootha, D. Singh & N. Kumar—NPL, New Delhi.

126508: A new design of instant cartridge water filter, N.N. Borthakur, A. C. Khazanchi & M.S. Iyengar—RRL, Jorhat.

126552: A process for the production of moulded shapes as an improved charge for ferro-silicon and/or ferro-alloy manufacture, A. Lahiri, A.K. Moitra, N.G. Banerjee, A.K. Chakravarthi, R. Ghosh & N. G. De—CFRI, Dhanbad.

Patents Accepted

Indian Pat. 116648
Chlorine tablets for disinfection of water supplies
B. N. Pathak & K. R. Bulusu
CPHERI, Nagpur

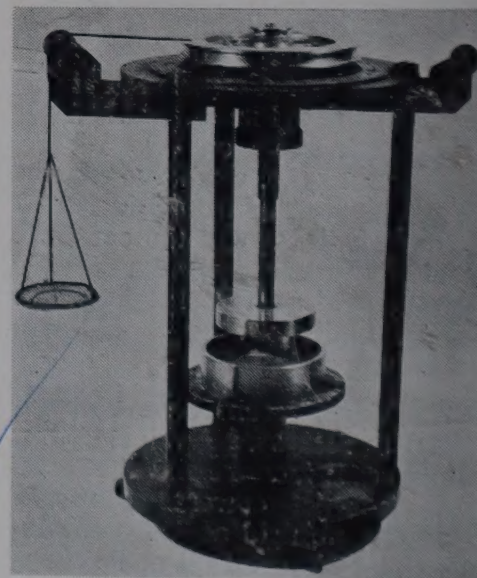
The need is felt on several occasions for a reliable method for disinfecting individual water supplies. Natural disasters like the earthquakes can cause disruption of water supplies and as a result individual procurement and treatment of water becomes necessary. Travellers often find it desirable to treat the drinking water. A special need exists in military operations on the front in which individuals or small groups may be separated from the regular water supply points for a considerable time. In such cases the chlorine tablets developed by CIPHERI, Nagpur become handy. Prepared from cheap indigenous materials like bleaching powder, the tablets on contact with water liberate chlorine which

acts as disinfectant. The product can be manufactured in 100, 200 and 500 mg weights and possesses good shelf-life—3 to 6 months without loss of chlorine if properly stored.

Indian Pat. 118034
Improvements in or relating to viscometers
S. S. Chari & B. R. Awasthy
NPL, New Delhi

A modification of the imported Stormer's viscometer, the newly developed instrument can be used for determining the absolute values of consistency unlike the imported one. Yield stress and thixotropy can also be measured with this instrument. The viscosity can be measured from 5 poises to any upper limit. The instrument has been thoroughly tested for butter, ghee, vegetable oils, concentrated polymer solutions, duplicating inks, tooth-pastes, ketchups, etc. It is simple in working and easy to handle. There is no other viscometer indigenously available which can measure viscosity above the range of 5 poises in absolute terms. Constant stress and shear rate prevail throughout the material taken in the viscometer. The material is introduced in the gap between two coaxial cylinders and the angular velocity of the inner cylinder is measured for a constant weight attached to the torque pulley.

The viscometer can be introduced as a standard for measuring consistency of materials above 5 poises.



Modified Stormer's viscometer